

A Survey of Machine Learning Methods for IoT and their Future Applications

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Abstract:

Machine learning empowers PCs to perform particular errands insightfully. Machine learning frameworks can perform complex tasks by learning from information rather than following pre-programmed rules. One of the center targets of machine learning is to train PCs to utilize information or past experience to tackle a given issue. Today, machine learning is utilized in numerous applications and is a central idea for savvy frameworks. This paper aims to provide a brief overview of machine learning methods for internet of things (IoT). In the final sections, we present some of the applications of machine learning in IoT.

Keywords: Machine Learning, Machine Learning Tasks, IoT, Applications.

1. Introduction

Machine learning (ML) is a field of study that may allude to computers learning from past understanding (past information) to enhance future execution. The main focus of this field is the ability of machines to use programmed learning techniques. Learning alludes to understanding or studying changes with reference to past encounters.



Fig. 1. Machine learning concept.

As opposed to building generous machines with unequivocal programming now one of a kind

computations are made available which will push the machine to grasp the virtual condition and in light of their understanding the machine will take particular decision. This will over the long haul decrease the quantity of programming thoughts and the machine will end up taking decisions in solitude. ML is used as a sort of Web look up for spam channels, prescribed structures, credit scoring, stock trading and various diverse applications. An ongoing report from the McKinsey Worldwide Institute affirms that machine learning (a.k.a. information mining or prescient investigation) will be the driver of the following enormous flood of developments [1]. In any case, a significant part of "society information" that is expected to effectively create ML applications isn't profit capable in totality. A few times, a number of ML algorithms take longer than should be expected in learning from a dataset and end up delivering not as much as expected [2], [3].

2. Literature survey

ML is the driving force for artificial intelligence (AI). The advantage ML systems is that it uses logical models, heuristic learning, data acquisitions and decision trees for fundamental administration [4]. Along these lines, it gives controllability, detectability and unfaltering quality to the system under administration. In more recent times, ML experts have shifted their focus more on algorithms which are viable, reliable and computationally less complex.

The utilization of machine learning models for human sickness helps remedy pros in light of the signs at a starting time, regardless of the way that a couple of ailments show practically identical indications. One of the basic issues in multivariate procedures is to pick pertinent features from the open course of action of the characteristics [6]. The typical

component decision procedures fuse wrapper subset evaluation, isolating and introduced models. Embedded models use classifiers to fabricate troupes, the wrapper subset evaluation method offers positions to features in perspective of their usefulness and channel procedures rank the features in perspective of truthful estimations. Each machine learning figuration has a specific system of learning and relies upon the estimations of its parameters. Exactly when an estimation is associated with a gathering issue with a substitute course of action of parameters, the portrayal exactness in like manner differentiates each situation [7]. Authors in [8], presented a survey of ML approaches for system identification using kernel method. In [9], the authors have introduced a three-tier IoT architecture for early detection of heart diseases using ML algorithms. A learning model is produced in perspective of the association between the marker property estimations and the estimation of the goal [10]. The test is to viably envision the class in light of learning of past data. In machine learning, this kind of collection issues are insinuated as controlled learning. Therefore there is a need to outfit an instructive list containing events with known classes and a test educational gathering procedure for which the class must be

settled. The accomplishment of the request limit for the most part depends upon the idea of data suited learning and moreover the kind of machine learning figuration used [11]. Author in [12], proposed a practical learning circumstance where there was little proportion of stamped data alongside a significant pool of unlabeled data and showed a framework for using the unlabeled data to improve the standard coordinated learning estimations. In [13], the authors have presented a kernel-based regularization method using Bayesian estimation of Gaussian processes. [14] have analyzed diverse managed learning procedures which were introduced 10 years ago and gave a broad scale exploratory relationship between ten regulated learning strategies. In [15], the authors have presented a survey of ML methods for internet traffic and its classification.

3. Machine learning algorithms

Machine learning assignments are ordinarily ordered into two general classes, contingent upon whether there is a learning "flag" or "criticism" accessible to a learning framework. The types of learning algorithms is shown in Fig. 1 and discussed in (a), (b), (c) and (d).

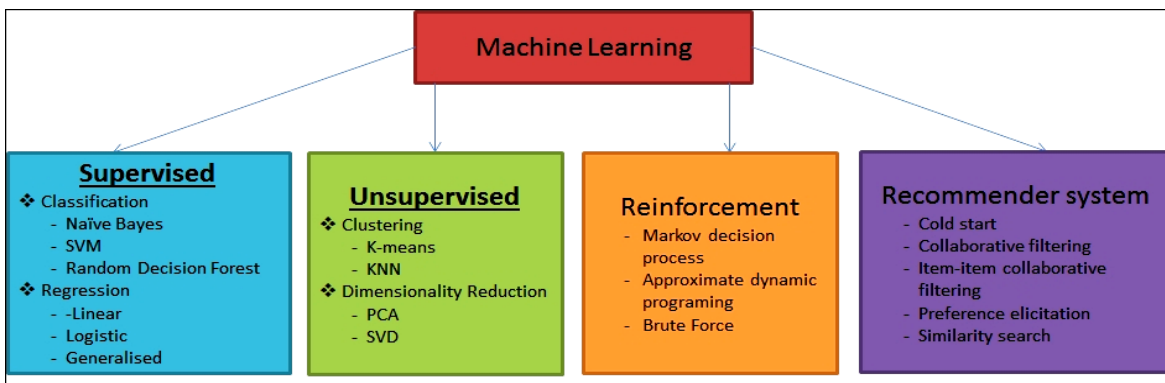


Fig. 2. Machine learning algorithms.

a. Supervised learning: In this type of learning, the output class labels of the data are known or can be calculated. In cases where the labels are unknown, their operational data will be available.

b. Semi-supervised learning: Here, learning is based on a set of unknown information which is generally deficient.

c. Reinforcement learning: A typical example of this type of learning is driving a vehicle [5].

c. Active learning: For this learning type, a PC can simply get information for a confined game plan of cases. Exactly when used instinctively, this information can be shown to the customer.

d. Unsupervised learning: No imprints, labelling or categorization are given to the learning computation. It isolates the information to find the structure in its data.

4. Real ML Workflow

- Gathering data
- Cleaning data
- Model building and choosing the correct calculation
- Gaining insights from the outcomes
- Visualizing the information



Fig. 3. Machine Learning Workflow.

5. ML learning strategies

In basic terms, ML algorithms can learn with or without human intervention. Such algorithms process input information with the assistance of scientific models and a combination of different parameters.

a. Learning based on illustrations

This technique implies that an arrangement of machine learning utilizes cases. Google has deployed this mechanism. It has also been employed in Google mail.

b. Learning based on understanding

The framework learns on past experience and activities.

c. Self-learning

Here, the propelled machine learning calculations breaks down various information structures without anyone else, separating some broad examples from them.

d. Profound learning

This technique requires more muddled scientific models that can be utilized to characterize pictures, substances or perceive discourse and so forth.

6. Points of interest of machine learning systems

Machine learning is an innovation which adds to the advancement and developments of many improvements seen today.

a. Picture acknowledgment

This element is entirely far reaching among versatile applications. For instance, it is now and again utilized

for distinguishing proof purposes or work with photographs including channels and altering. Also, utilizing distinctive kinds of machine learning calculations you can characterize clients sex and age inside an application, identify unique marks and locate objects within images. A decent case of a machine learning application is the acknowledgment of tags on streets if there should arise an occurrence of infringement.

b. Voice acknowledgment

A typical example of this is Apple's Siri and Google, who now utilize a rundown of machine learning calculations to perceive the client's orders and respond to them.

c. Optical character acknowledgment

For clients, this element perceives records, charge cards, decipher outside words or characters on pictures and so forth. It is critical to consider that content has an assortment of qualities, for example, the textual style, size etc. That is the reason each model of machine learning ought to be manufactured having these qualities at the top of the priority list.

d. Propelled customization

This discusses the making of customized content that will have the capacity to consider the clients inclinations.

7. Machine Learning Applications in IoT

Today a number of applications use and depend on the concept of ML. Applications of data science such as search engines, data mining and information retrieval systems, big data analysis all use ML

algorithms in one form or the other feature extraction. Furthermore, ML finds applications in computer vision for object identification [16], for Web content management for text classification [17], for future applications in nuclear engineering for calculation of reactor criticality [18] and burn-up rates [19], for feature extraction and selection [20].

The most recent application of ML is in the area of IoT. IoT is the interconnection of devices with the sole aim of sharing information. More recently, authors in [21] presented a survey of IoT and its applications with IoT built engineering. This survey gave a comprehensive overview of future trends in IoT. A combination of ML and IoT has been employed in cyber security systems for intrusion detection using a data mining approach [22]. Authors in [23], presented some solutions to few of the challenges in data processing and extraction using IoT platforms for data mining applications.

8. Conclusion

The chief focus of ML scientists is to outline more productive (both in time and space) learning strategies that can perform better in various applications to save time and cost. In this paper, we have tried to provide an overview of the types of ML, ML task and its applications as related to IoT. In conclusion, it is needful to mention that ML provides higher precision in calculations and for prediction, it is highly effective and is able to look at a lot of information in smaller interims of time.

REFERENCE

- [1] Manyika, J., Chui, M., Brown, B., Bughin, J., Dobbs, R., Roxburgh, C. and Byers, A., Big data: The next frontier for innovation, competition, and productivity. Technical report, McKinsey Global Institute, 2011.
- [2] Mitchell, T. M. Machine Learning, McGraw-Hill, New York, NY, 1997.
- [3] Aldrich, A. and Auret, L., Unsupervised process monitoring and fault diagnosis with machine learning methods, Springer, 2013.
- [4] Mandal, I., and Sairam, N., Accurate prediction of coronary artery disease using reliable diagnosis system, *Journal of Medical Systems*, 36(5), 3353-3373, 2012.
- [5] Mandal, I. and Sairam, N., Enhanced classification performance using computational intelligence, *Communications in Computer and Information Science*, 204, 384-391, 2011.
- [6] Mandal, I. and Sairam, N., New machine-learning algorithms for prediction of Parkinson's disease, *International Journal of Systems Science*, 45(3), 647-666, 2014.
- [7] Feng, G., Qian, Z. and Zhang, X., Evolutionary selection extreme learning machine optimization for regression, *Soft Computing*, 16 (9), 1485-1491, 2012. DOI: 10.1007/s00500-012-0823-7
- [8] Pillonetto, G., Dinuzzo, F., Chen, T., Nicolao, G. D. and Ljung, L., Kernel methods in system identification, machine learning and function estimation: A survey, *Automatica*, 50, 657-682, 2014.
- [9] Kumar, P. M. and Gandhi, U. D., A novel three-tier Internet of Things architecture with machine learning algorithm for early detection of heart diseases, *Computers and Electrical Engineering*, 1-14, 2017.
- [10] Silva, J. D. A. and Hruschka, E. R. An experimental study on the use of nearest neighbor based imputation algorithms for classification tasks, *Data and Knowledge Engineering*, 84, 47-58, 2013.
- [11] Gao, S., Xu, S., Fang, Y. and Fang, J., Prediction of core cancer genes using multi-task classification framework, *Journal of Theoretical Biology*, 317, 62-70, 2013. DOI: 10.1016/j.jtbi.2012.09.027.
- [12] Jayavardhana, G., Internet of things (IoT): A vision, architectural elements, and future directions, *Future Generation Computer Systems*, 29(7), 1645-1660, 2013.

- [13] Luo, X., Liu, J., Zhang, D. and Chang, X., A large-scale web QoS prediction scheme for industrial internet of things based on kernel machine learning algorithm, *Computer Networks*.
[Http://dx.doi.org/10.1016/j.comnet.2016.01.004](http://dx.doi.org/10.1016/j.comnet.2016.01.004)
- [14] Caruana, R. and Niculescu-Mizil, A., An empirical comparison of supervised learning algorithms, Department of Computer Science, Cornell University, USA, 2011.
- [15] Nguyen, T. T. and Armitage, G., A survey of techniques for internet traffic classification using machine learning, *IEEE Communications Surveys and Tutorials*, 10(4), 2008.
- [16] Salau, A. O., Development of a vehicle plate number localization technique using computer vision, PhD Thesis, Obafemi Awolowo University, Ile-Ife, Nigeria, 200, 2018.
- [17] Agarwal, B. and Mittal, N., Text Classification Using Machine Learning Methods-A Survey, *Proceedings of the Second International Conference on Soft Computing 701 for Problem Solving (SocProS 2012)*, December 28–30, 2012, DOI: 10.1007/978-81-322-1602-5_75.
- [18] Ojo, B. M., Fasasi, M. K., Salau, A. O., Olukotun, S. F. and Jayeola, M. A. (2018). Criticality Calculation of a Homogenous Cylindrical Nuclear Reactor Core using Four-group Diffusion Equations, *Turkish Journal of Engineering*, 2(3), pp. 130-138. DOI: 10.31127/tuje.411549
- [19] Amosun, A. A., Salau, A. O., Fadodun, O. G., Jayeola, M. A., Osanyin, T. K., Fasasi, M. K. and Ibitoye, F. I., Numerical calculation of fuel burn-up rate in a cylindrical nuclear reactor, *Journal of Radioanalytical and Nuclear Chemistry*, Springer, 318(3), 1-12, 2018. DOI: 10.1007/s10967-018-6361-8
- [20] Chandrashekar, G. and Sahin, F., A survey on feature selection methods, *Computers and Electrical Engineering*, 40, 16–28, 2014.
- [21] Kumar, A., Salau, A.O., Gupta, S. and Paliwal, K., Recent trends in IoT and its requisition with IoT built engineering: A review. In: Rawat, B., Trivedi, A., Manhas, S., Karwal, V. (eds) *Advances in Signal Processing and Communication. Lecture Notes in Electrical Engineering*, 526, 15-25, 2019. Springer Singapore. DOI: 10.1007/978-981-13-2553-3_2
- [22] Buczak, A. L. and Guven, E., A survey of data mining and machine learning methods for cyber security intrusion detection, *IEEE Communications Surveys and Tutorials*, 18(2), 1153-1176, 2016.
- [23] Tsai, C. W. Lai, C. F. Chiang, M. C. and Yang, L. T., Data mining for internet of things: A survey, *IEEE Communications Surveys and Tutorials*, 16(1), 77-97, 2014.